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A KEY TO THE GENERA OF ANISOPTEROUS DRAGONFLY NYMPHS OF THE UNITED STATES AND CANADA (ODONATA, SUBORDER ANISOPTERA)

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Since the publication of "A Handbook of the Dragonflies of North America" by Needham and Heywood in 1929, much additional information concerning the immature stages has been accumulated and nymphs of a number of previously unknown genera and species have been described. Several students of the Odonata (Byers, 1936, and Needham and Fisher, 1936), have published revised keys to certain families or subfamilies, but no comprehensive key to the order as a whole has as yet appeared. This paper covers all of the genera of Anisopterous dragonflies known from North America north of Mexico. Keys are presented for the identification of the genera and a list of available literature for specific identification is appended. A glossary of all terms used and illustrations of the majority of the structures of nymphs are included. It is suggested that the beginning student study closely figures E and F of Plate 1, figures L and N of Plate 3, figure G of Plate 4, and figure J of Plate 5 before attempting to use the keys. In these figures are illustrated most of the structures used in the generic identification of Odonata nymphs.

The senior author is responsible for the greater portion of the taxonomic part of this paper, while the junior author has contributed the many illustrations and has helped on the other portions. It was intended at first to present keys to the whole order, but due to our lack of material in certain genera and to the extreme uniformity of the genera of the *Coenagrionidae*, we have decided to delay publication of the section on *Zygoptera* until more material and time for study are available.

It is our hope that these keys will be useful particularly to students of aquatic biology and to those engaged in the study of foods of fish and aquatic birds. We are grateful for the constructive criticism coming from the many students in various entomological classes and to the workers in food analysis who have used this key. We are particularly indebted to Dr. E. M. Walker for his examination and much constructive criticism of this manuscript. Thanks are due to the University of Michigan Museum of Zoology for the loan of much material used in the preparation of these keys. Any criticisms or corrections from students using these keys will be gratefully received by the authors.

The following key is most successful with late instar nymphs. Also nymphs killed and preserved in 95 per cent ethyl alcohol have proven to be more satisfactory for examination and identification than specimens killed or preserved in some other manner.

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KEYS TO GENERA FOR NYMPHS OF ANISOPTERA (ODONATA) OF THE UNITED STATES AND CANADA

KEY TO SUB-ORDERS AND FAMILIES OF THE ODONATA

1. External gills present in the form of three flat triangular vertical plates at end of abdomen; head wider than thorax and abdomen (6A) ..... Suborder ZYGOPTERA. 2
   External gills absent; head not wider than abdomen and thorax (1A), Suborder ANISOPTERA. 4
2. First antennal (6E) segment as long as the six succeeding segments together; mentum with a deep and open median cleft (6D) ..... AGRIONIDAE
   Antennal segments all of approximately the same size (6A); mentum entire or with a closed median cleft (6F) 3
3. Mentum with a median closed cleft; the mentum spoon shaped, its base reaching to mesothoracic coxae or beyond (6B) ..... LESTIDAE
   Mentum entire, without a median cleft; mentum flat, not spoon shaped, its base not reaching much beyond prothoracic coxae (6C) ..... COENAGRIONIDAE
4. Labium flat, or nearly so; without stout setae on the mentum (3P) 5
   Labium spoon-shaped, covering the face to the base of the antennae (1F); mentum armed with stout setae (3L) 7
5. Antennae 4-segmented (3 C, D, E); pro and metatarsi with but 2 segments (1A), GOMPHIDAE
   Antennae 6- or 7-segmented (3 A, B); all tarsi with 3 segments (with the exception of *Gomphaeschna* in which the fore tarsi have but 2 segments) 6
6. Antennal segments short, thick, and heavily setiferous (3B); a pair of latero-dorsal tufts of long black bristles on abdominal segments 2 or 3 to 9 (4K) ..... PETALURIDAE
   Antennal joints slender and bristle-like (3A); no latero-dorsal abdominal hair tufts present, AESHNIDAE
7. Distal edge of lateral lobe with large, irregular teeth (3H); mentum with a median cleft, CORDULEGASTERIDAE
   Distal edge of lateral lobe entire, or with small, even-sized crenulations or teeth (3I); mentum lacking a median cleft ..... LIBELLULIDAE

Family PETALURIDAE

There are but two genera of this family known from the United States and each is represented by but a single species. Only the nymph of the eastern species is at present known.

The species are: *Tanypteryx hageni* Selys (western) and *Tachopteryx thoreyi* Hagen (eastern).

Family GOMPHIDAE

KEY TO GENERA

1. Tenth abdominal segment nearly as long as all other abdominal segments combined (4 E), **Gomphoides williamsoni**
   Tenth abdominal segment shorter than eighth and ninth abdominal segments combined (4 A–D) 2
2. Mesocoxae closer together at base than procoxae (4 I); fourth antennal segment elongate, as long as first antennal segment (3 E) ..... **Progomphus**
   Procoxae and mesocoxae approximately same distance apart at their bases (4 J); fourth antennal segment never as above, usually a small rounded knob (3 C, D) 3
3. Wing cases divergent not parallel with meson (1 C) 4
   Wing cases parallel with meson (1 A) 5
4. Dorsal hooks present on abdominal segments 2 or 3 to 9; those on the caudal segments being hook-like and curved dorsad ..... **Ophiogomphus**
   Dorsal hooks present only on abdominal segments 2 to 4; segments 8 and 9 may have a slight thickening on the mid-dorsal line, but these are never as described above, **Erpetogomphus**

EXPLANATION OF PLATE 1

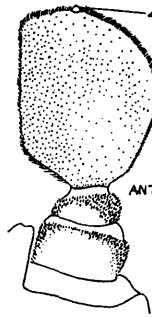
ANISOPTERA

A. Dorsal view of *Hagenius*.
B. Antenna of *Hagenius*.
C. Dorsal view of *Ophigomphus*.
D. Antenna of *Lanthus*.
E. Dorsal view of *Epicordulia*.
F. Lateral view of *Epicordulia*.

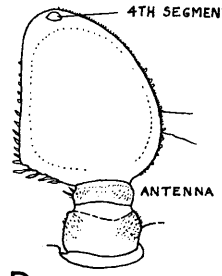
ODONATA – ANISOPTERA PLATE I.

NYMPHS AND ANTENNAE

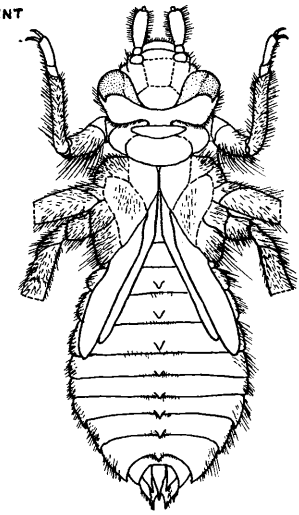
A. HAGENIUS
DORSAL VIEW



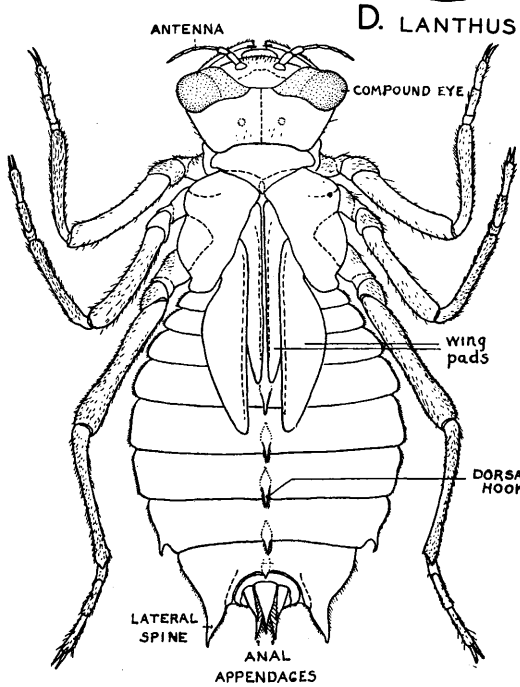
B. HAGENIUS



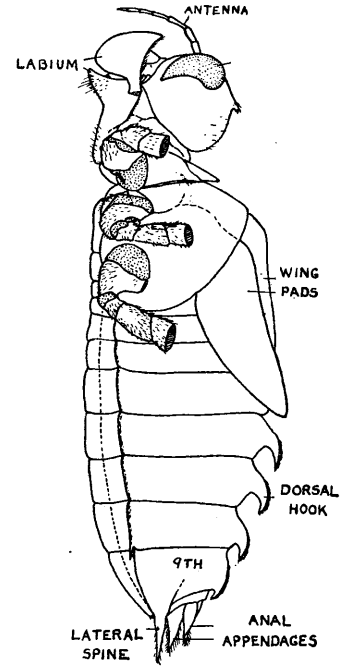
D. LANTHUS



C. OPHIOGOMPHUS
DORSAL VIEW



E. EPICORDULIA
DORSAL VIEW



F. EPICORDULIA
LATERAL VIEW

5. Third antennal segment thin, flat, and suboval (1 B, D)....6
   Third antennal segment elongate or linear, usually cylindrical (3 C)....8
6. Body depressed; abdomen subcircular, almost as wide as long (1 A)....**Hagenius**
   Body not so depressed; abdomen twice as long as wide (1 C)....7
7. Short lateral spines present on abdominal segments 7 to 9; third antenna, segment narrow, about twice as long as wide (3 D)....**Octogomphus**
   Short lateral spines present on abdominal segments 8 and 9; third antennal segment wide, fully as wide as long (1 D)....**Lanthus**
8. Abdominal segment 9 rounded dorsally and without a sharp apical spine (=dorsal hook); or, if a dorsal hook is present on abdominal segment 9, then the segment is longer than wide at its base (4 C, D)....**Gomphus**
   Abdominal segment 9 with an acute mid-dorsal ridge with a spine (=dorsal hook) at its apex; this segment never as long as wide at its base (4 A, B)....9
9. Lateral anal appendages as long as the superior appendage; fourth antennal segment a conspicuous upturned conic rudiment about as long as the second segment..**Gomphoides**
   Lateral anal appendages never more than three-fourths the length of the superior appendage (4 A); fourth antennal segment a small round structure, not as described above (3 C)....**Dromogomphus**

Family AESHNIDAE

KEY TO GENERA

1. Lateral lobes of labium with stout lateral setae....**Gynacantha, Triacanthagyna**
   Lateral lobes lacking any lateral setae (3 O, P)....2
2. Protarsi with 2 segments, meso and metatarsi with 3 segments....**Gomphaeschna**
   All tarsi with 3 segments....3
3. Distal border of mentum with a pair of sharp, parallel spines, one on each side of the mental cleft (3 O)....**Coryphaeschna**
   Distal border of mentum not so armed (3 P)....4
4. Lateral spines present on abdominal segment 7 to 9, (*see Note 2*)....**Anax**
   Lateral spines present on abdominal segments 4, 5 or 6 to 9....5
5. Caudo-lateral margin of head from dorsal view with two large, well-developed tubercles (2 L); apex of superior anal appendage truncate or but feebly emarginate (4 H); eyes small, occupying only one-third of the lateral margin of the head (2 L)....6
   Caudo-lateral margin of head from dorsal view never with two tubercles as described above (2 K); apex of superior anal appendage deeply emarginate (4 F, G); eyes large, occupying about half of the lateral margin of the head (2 K)....7
6. Low but distinct dorsal hooks (best seen from lateral view) present on abdominal segments 7 to 9 (4 H); apex of lateral lobe broadly rounded; lateral anal appendages less than half the length of the superior....**Nasiaechna**
   Dorsal hooks absent on all abdominal segments; apex of lateral lobe truncate; lateral anal appendages more than half the length of the superior....**Epiaeschna**

Note 2. Two species of the genus *Aeshna* (*A. caerulea* Burm. and *A. sitchensis* Hagen) have lateral spines on segments 7 to 9 only. They would thus key out to Anax. Calvert (1934) reports an occasional individual of *Anax junius* with small lateral spines on segment 6. The larger size of the Anax nymphs should be indicative, but the following characters are useful when in doubt (applicable to fully or nearly grown individuals). *Anax*—superior anal appendage but slightly shorter than inferior; inferiors about one and one-half times as long as mid-dorsal length of segments 9 and 10; male appendate (on dorsum of superior appendage) truncate or concave at apex and half or less than half the length of the lateral appendages; ovipositor (in *A. junius*) only about two-thirds the length of segment 9, not reaching hind margin of 9. *Aeshna*—(lateral spines on segments 7 to 9 only); superior appendage about one-fourth shorter than inferiors; inferiors about subequal in length to mid-dorsum of segments 9 and 10; male appendage triangular with a blunt, rounded apex and about three-fourths as long as lateral appendages; ovipositor reaching to proximal third or fourth of segment 10.

EXPLANATION OF PLATE 2

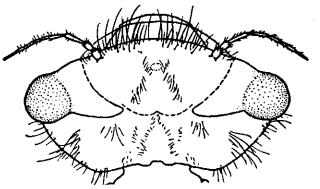
ANISOPTERA

Heads, all dorsal views except figure N.

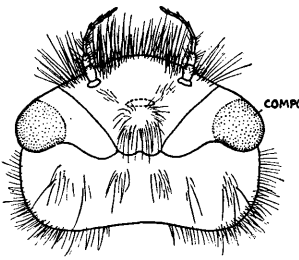
A. *Libellula.*
B. *Plathemis.*
C. *Paltothemis.*
D. *Somatochlora.*
E. *Platycordulia.*
F. *Neurocordulia.*
G. *Tramea.*
H. *Pachydiplax.*
I. *Leucorrhinia.*
J. *Celithemis.*
K. *Basiaeschna.*
L. *Nasiaeschna.*
M. *Macromia.*
N. *Macromia,* lateral view.
O. *Octogomphus.*

ODONATA – ANISOPTERA. PLATE 2.

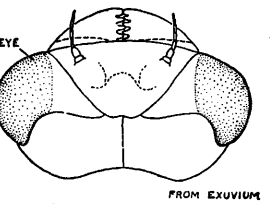
HEADS – DORSAL



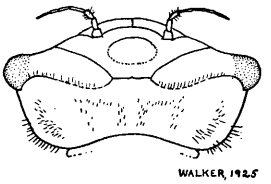
A. LIBELLULA



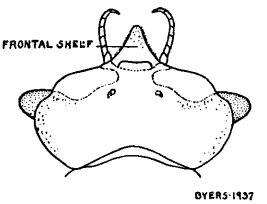
B. PLATHEMIS



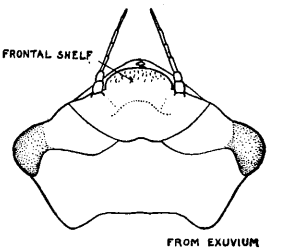
C. PALTOTHEMIS



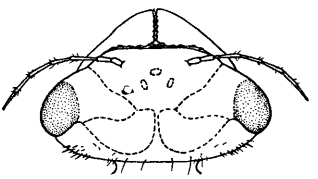
D. SOMATOCHLORA



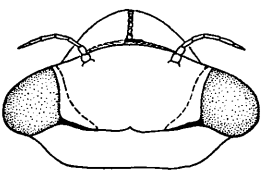
E. PLATYCORDULIA



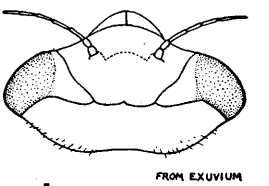
F. NEUROCORDULIA



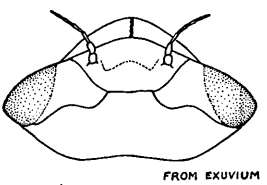
G. TRAMEA



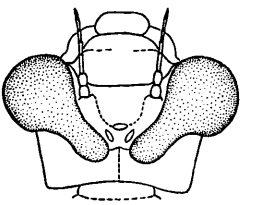
H. PACHYDIPLAX



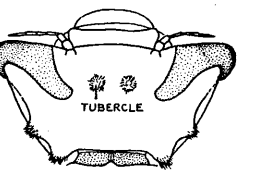
I. LEUCORRHINIA



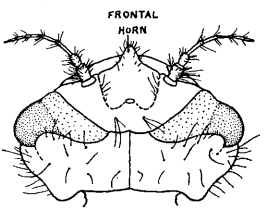
J. CELITHEMIS



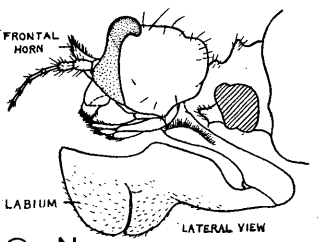
K. BASIAESCHNA



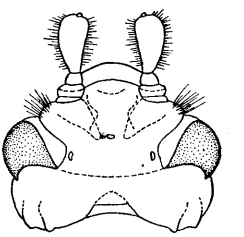
L. NASIAESCHNA



M. MACROMIA



Ⓡ N. MACROMIA



O. OCTOGOMPHUS

KENNEDY 1917

7. Lateral spines present on abdominal segments 6 to 9; if there is a small spine on segment 5 then the caudo-lateral margin of the head is rounded and the lateral anal appendages one-half or greater than one-half the length of the inferiors (*see Note 2*).....**Aeshna**
   Lateral spines present on abdominal segments 4 or 5 to 9; caudo-lateral margins of the head distinctly angulate, or, if obtusely angulate or rounded, then the lateral anal appendages are but one-fourth the length of the inferiors.....7
8. Lateral lobe of labium obtuse or subtruncate at tip (3 F); median border of lateral lobe with distinct, more or less square-cut teeth.....**Boyeria**
   Lateral lobe of labium with a taper pointed tip (3 G); median border of lateral lobe with indistinct denticulation.....**Basiaeschna**
9. Nymphs unknown.....**Oplonaeschna**

Family CORDULAEGASTERIDAE

The majority of the papers found in the literature include all species of this group found in our fauna in one genus, Cordulaegaster. Byers (1930), however, lists three genera. His discussion of this family is worthy of note and is to be found on pages 82 to 89 in his monograph.

Family LIBELLULIDAE

KEY TO SUBFAMILIES

1. Head with a prominent frontal horn between the bases of the antennae (2 M, N), **Macromiinae**
2. Head without such a projection (2 A, D).....**Corduliinae, Libellulinae**

Subfamily MACROMIINAE

KEY TO GENERA

1. Lateral spines of ninth abdominal segment reaching less than half way to apex of anal appendages (5 A); cephalic margin of head noticeably wider than caudal margin (2 M), **Macromia**
   Lateral spines of ninth abdominal segment reaching to apex of anal appendages (5 B); cephalic and caudal margins of head subequal in width.....**Didymops**

Subfamilies CORDULIINAE and LIBELLULINAE

There are no points which will separate all of the members of one subfamily from all of the members of the other subfamily, hence the genera are keyed out together. In compiling this key liberal use has been made of many sources, the most important among them being Byers (1936) and Needham (1936).

KEY TO GENERA

1. Abdomen with dorsal hooks or knobs present on one or more segments.....2
   Abdomen with dorsal hooks or knobs absent on all segments.....21
2. A dorsal hook or knob present on abdominal segment 9.....3
   No dorsal hook or knob present on segment 9.....12
3. Lateral spines of abdominal segment 9 reaching to or beyond the tips of the anal appendages (1 E, F; 5 C).....4
   Lateral spines of segment 9 short, not reaching to tip of anal appendages (5 E–H).....7
4. Lateral spines of segment 8 set at an angle to the long axis of the abdomen, not parallel to those of segment 9 (5 C, D).....5
   Lateral spines of segment 8 not at an angle, usually parallel to those of segment 9 (1 E)...6

EXPLANATION OF PLATE 3

ANISOPTERA

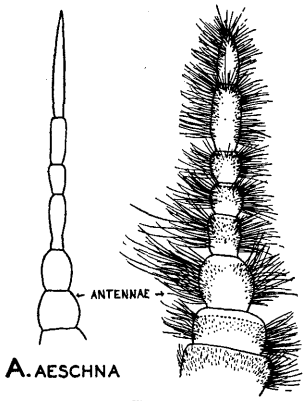
A. Antenna of *Aeschna.*
B. Antenna of *Tachopteryx.*
C. Antenna of *Dromogomphus.*
D. Antenna of *Octogomphus.*
E. Antenna of *Progomphus.*
F. Lateral lobe of *Boyeria.*
G. Lateral lobe of *Basiaeschna.*
H. Lateral lobe of *Cordulegaster.*
I. Lateral lobe of *Pantala.*
J. Lateral lobe of *Tramea.*
K. Mentum and lateral lobes of *Libellula.*
L. Mentum and lateral lobes of *Epicordulia.*
M. Mentum and lateral lobes of *Plathemis.*
N. Mentum and lateral lobes of *Dromogomphus.*
O. Mentum and lateral lobes of *Coryphaeschna.*
P. Mentum and lateral lobes of *Aeschna.*
Q. Antenna of *Pachydiplex.*

Figures K to P show dorsal surface (inner surface of mentum when labium is at rest).

ODONATA - ANISOPTERA

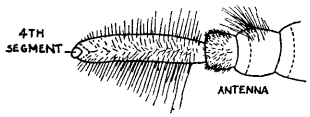
PLATE 3.

ANTENNAE AND PARTS OF LABIUM

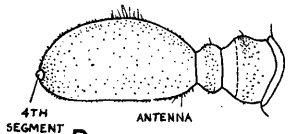


A. AESCHNA

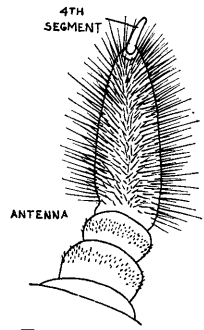
B. TACHOPTERYX



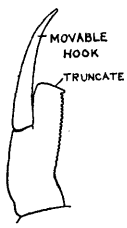
C. DROMOGOMPHUS

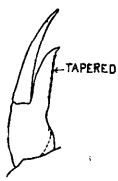


D. OCTOGOMPHUS

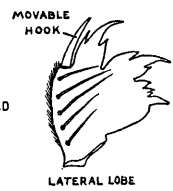


E. PROGOMPHUS

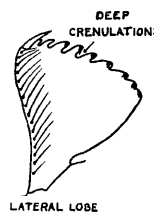




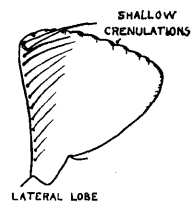
F. BOYERIA G. BASIAESCHNA



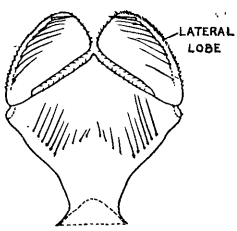
H. CORDULEGASTER



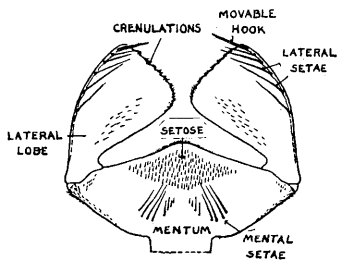
I. PANTALA



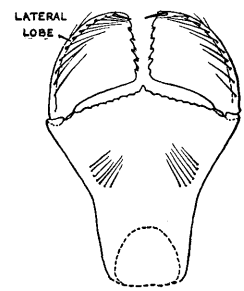
J. TRAMEA



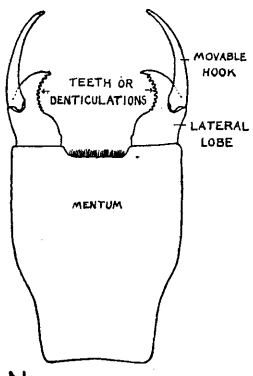
K. LIBELLULA



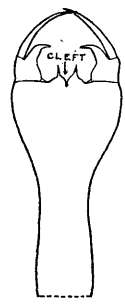
L. EPICORDULIA



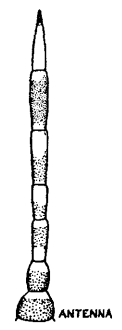
M. PLATHEMIS



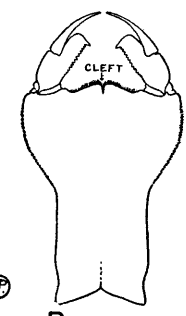
N. DROMOGOMPHUS



O. CORYPHAESGHNA



Q PACHYDIPLAX



P. AESCHNA

5. Frontal shelf, between bases of the antennae, produced into a prominent flat triangle (2 E), **Platycordulia**
   Frontal shelf, between bases of the antennae, low and rounded, not produced into a flat triangle (2 F) ..... **Neurocordulia**
6. Distal half of dorsal surface of mentum heavily setose; lateral setae 4 to 5 (3 L), **Epicordulia**
   Distal half of dorsal surface of mentum with few or generally no setae; lateral setae 6 to 8, **Tetragoneuria**
7. Superior and inferior anal appendages long; as long as mid-dorsal length of abdominal segments 8 and 9 (5 E) ..... **Cannacria**
   Superior and inferior anal appendages short; shorter than mid-dorsal length of abdominal segments 8 and 9, usually not longer than mid-dorsal length of either segment (5 H), 8
8. Lateral anal appendages nearly as long as the superior appendge 9
   Lateral anal appendages one-half or less the length of superior appendage 10
9. Dorsal hooks absent on segments 3 to 4, crenulations of the lateral lobes deep (3 I), **Helocordulia**
   Dorsal hooks present on segments 3 and 4; crenulations of lateral lobes shallow (3 J), **Somatochlora**
10. Mental setae 9–10; length when full grown less than 18 mm.; dorsal hooks on segments 3–9 11
    Mental setae 14–15; length 24 mm. when full grown; dorsal hooks on segments 2–9, **Brechmorhoga**
11. Lateral setae 5; crenulations of distal margin of lateral lobe deep ..... **Perithemis**
    Lateral setae 7–10; crenulations of lateral lobe obsolete ..... **Dythemis**
12. Eyes at side lateral of head, (2 G, H, I and J, *see Note 3*) 13
    Eyes capping the cephalo-lateral angles of the head, more frontal than lateral, (2 A, B and C, *see Note 3*) 17
13. Lateral setae 7; lateral anal appendages nearly as long as superior appendage .. **Dorocordulia**
    Lateral setae 7 to 14; lateral anal appendages usually about half the length of the superior appendage 14
14. Dorsal hook present on segment 3; inferior anal appendages subequal in length to superior appendage 15
    Dorsal hook absent on segment 3; inferior anal appendages markedly longer than superior appendage 16
15. Dorsal hook present on segment 2; lateral spines of segment 9 as long or longer than lateral margin of segment ..... **Macrodiplax**
    Dorsal hook absent on segment 2; lateral spines of segment 9 one-half or less the length of segment 9; or if as long the apex not curved medially ..... **Leucorrhinia** (in part)
16. Lateral spines of abdomen long and straight, those of segment 9 extending to or beyond the tips of the inferior anal appendages ..... **Celithemis**
    Lateral spines of abdomen short, not reaching tips of anal appendages, curved toward meson (5 F) ..... **Sympetrum** (in part)
17. Inferior and superior anal appendages subequal in length 18
    Inferior anal appendages noticeably longer than the superior ..... **Sympetrum** (in part)
18. Mental setae 0 to 4 ..... **Ladona**
    Mental setae 8 to 15 (3 K) 19
19. Body smooth; mental setae 14 to 15; low dorsal hooks on segments 2 to 6; crenulations of lateral lobes very deep (3 I) ..... **Paltothemis**
    Body hairy; mental setae 8 to 13; dorsal hooks on segments 3 to 6 or 8; crenulations moderate or absent (3 J) 20
20. Median lobe of labium crenulate on its distal margin (3 M); abdominal segments 7 to 9 with black, shining mid-dorsal ridges ..... **Plathemis**
    Median lobe of labium evenly contoured (3 K); abdominal segments 7 to 9 without such ridges ..... **Libellula**

Explanation of Plate 4

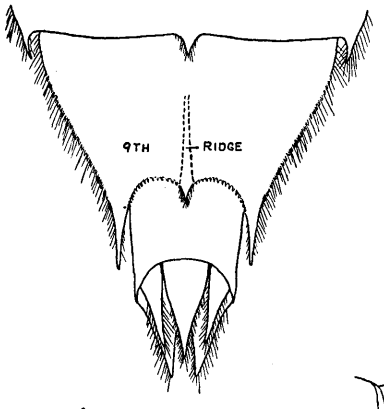
ANISOPTERA

A. Dorsal view of caudal segments of *Dromogomphus*.
B. Lateral view of caudal segments of *Dromogomphus*.
C. Dorsal view of caudal segments of *Gomphus*.
D. Lateral view of caudal segments of *Gomphus*.
E. Dorsal view of caudal segments of *Gomphoides*.
F. Ventral view of caudal segments of *Basiaeschna*.
G. Dorsal view of caudal segments of *Basiaeschna*, parts named.
H. Dorsal view of caudal segments of *Nasiaeschna*.
I. Ventral view of thorax of *Progomphus*.
J. Ventral view of thorax of *Gomphus*.
K. Dorsal view of caudal segments of *Tachopteryx*.

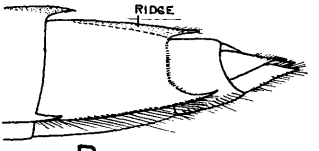
ODONATA - ANISOPTERA

PLATE 4.

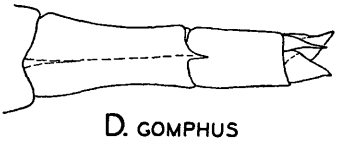
CAUDAL SEGMENTS &c



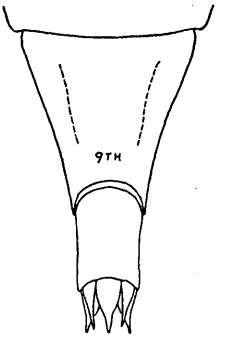
A. DROMOGOMPHUS
DORSAL VIEW



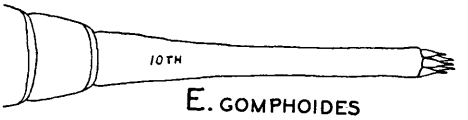
B. DROMOGOMPHUS
LATERAL VIEW



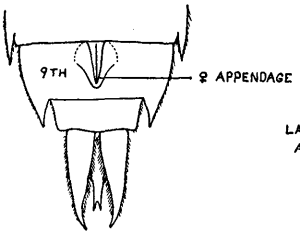
D. GOMPHUS
LATERAL VIEW



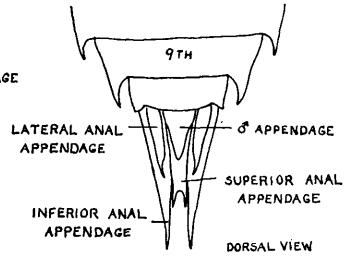
C. GOMPHUS
DORSAL VIEW



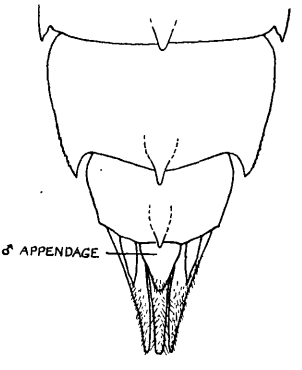
E. GOMPHOIDES
DORSAL VIEW



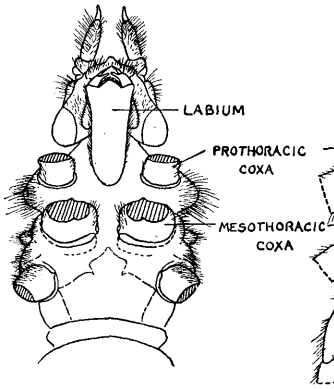
F. BASIAESCHNA
VENTRAL VIEW



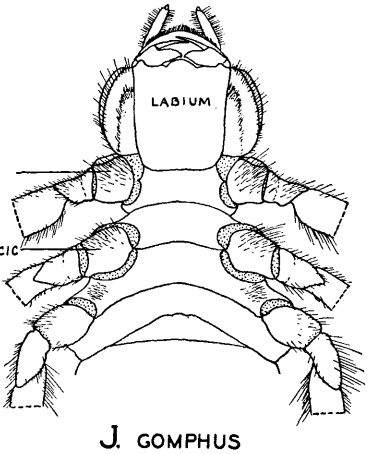
G. BASIAESCHNA



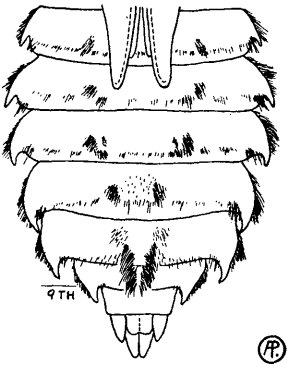
H. NASIAESCHNA
DORSAL VIEW



I. PROGOMPHUS
VENTRAL VIEW



J. GOMPHUS
VENTRAL VIEW



K. TACHOPTERYX
DORSAL VIEW

21. Apical third of inferior and lateral anal appendages strongly decurved (5 G)....22
Apical third of all anal appendages straight, not decurved ventrally (5 I)....23
22. A minute lateral spine on abdominal segment 9; lateral setae 11 or 12....**Lepthemis**
No lateral spines on abdomen; lateral setae 7 to 9....(=**Mesothemis**) **Erythemis**
23. Eyes capping the cephalo-lateral angles of the head, usually small and not very prominent (2 A, B and D, *see Note 3*)....24
Eyes at the side lateral of the head, large and prominent on a usually triangular shaped head (2 G, H and I, *see Note 3*)....29
24. Lateral anal appendages nearly as long as the superior....25
Lateral anal appendages one-third to one-half as long as the superior; crenulations of lateral lobes shallow or absent (3 J)....27
25. Crenulations of the distal margin of the lateral lobe obsolete, merely indicated by about fifteen single spinules....**Pseudoleon**
Crenulations of the distal margin of the lateral lobe deep with groups of 2–7 spinules on each tooth....26
26. A dark longitudinal stripe present along the dorso-lateral margins of the thorax...**Cordulia**
Thorax unicolored, no such stripe present....**Somatochlora** (in part)
27. Lateral spines present on abdominal segments 8 and 9....28
Lateral spines present only on abdominal segment 9....**Tarnetrum**
28. Mentum with distal margin crenulate (3 M); abdominal segments 4 to 7 with dorsal tufts of long hair....**Orthemis**
Mentum with distal margin entire, evenly contoured (3 K); abdominal segments 4 to 7 not as above....**Libellula**
29. Anal appendages long, slender and needle-pointed; lateral spines of segments 8 and 9 long and curved toward meson, those on segment 8 at least as long as mid-dorsal length of segment 9 (5 J, K)....30
Anal appendages short and heavy, not projected into a long, needle-point; lateral spines on segments 8 and 9 flat and straight, those on 8 not as long as mid-dorsal length of segment 9 (5 I)....31
30. Lateral spines of abdominal segment 8 but slightly shorter than those of segment 9; lateral spines of segment 9 reaching tips of anal appendages (5 J): crenulations of distal margin of lateral lobe shallow (3 J)....**Tramea**
Lateral spines of abdominal segment 8 only one-third size of those of segment 9; lateral spines of segment 9 not reaching tips of anal appendages (5 K); crenulations of distal margin of lateral lobe deep (3 I)....**Pantala**
31. Lateral setae 6 to 7; lateral anal appendages more than half as long as the inferiors....32
Lateral setae 9 to 14; lateral anal appendages less than half as long as inferiors....33
32. Lateral setae 6; mental setae 9 to 11; inferior and superior anal appendages subequal in length....**Nannothemis**
Lateral setae 7; mental setae about 14; inferior anal appendages longer than superior appendage....**Cordulia**
33. Lateral spines absent on segment 8....**Tarnetrum**
Lateral spines present on segment 8....34
34. Lateral spines of abdominal segments 8 and 9 subequal in length; some species with prominent bunches of setae present on the dorsum of abdominal segments 4 to 9, **Erythrodiplax**
Lateral spines of abdominal segments 8 and 9 unequal in length; those of segment 8 about half those of segment 9; never with prominent bunches of setae as described above (5 I)....35
35. Lateral spines of segment 9 equal to or greater than the mid-dorsal length of segment 9 (5 I); antennae colored black and white (3 Q); a dark colored ridge running mesad from meso-caudal portion of eye (2 H)....**Pachydiplax**
Length of lateral spines of segment 9 less than the mid-dorsal length of segment 9; antennae not colored as above; no ridge running mesad from eyes as described above (2 I)....**Leucorrhinia** (in part)
36. Nymphs unknown....**Williamsonia**

Note 3. In certain cases the position of the eyes on the head is a difficult point to determine; in such instances the specimens should be run through both forks of the key.

Explanation of Plate 5

ANISOPTERA

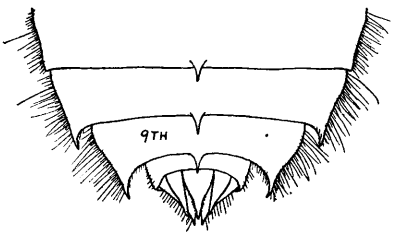
Caudal segments of abdomen, all dorsal views except G.

A. *Macromia.*
B. *Didymops.*
C. *Neurocordulia obsoleta* Say.
D. *Neuroorcdulia yamaskanensis* Prov.
E. *Cannacria.*
F. *Sympetrum.*
G. *Mesothemis*, lateral view.
H. *Perithemis.*
I. *Pachydiplax.*
J. *Tramea*, parts named.
K. *Pantala.*

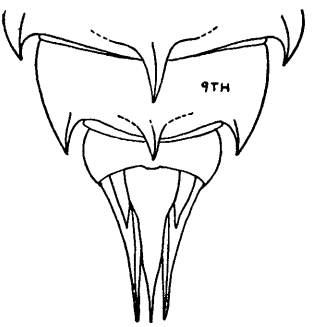
ODONATA – ANISOPTERA PLATE 5.

CAUDAL SEGMENTS

DORSAL VIEWS

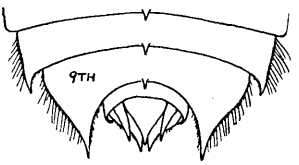


A. MACROMIA

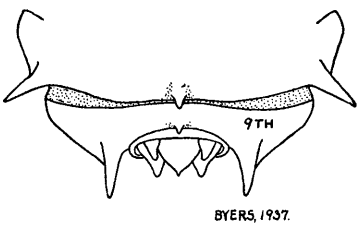


BYERS, 1936

E. CANNACRIA

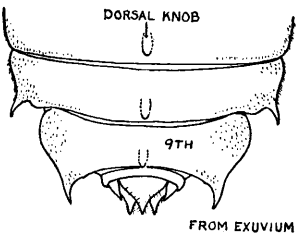


B. DIDYMOPS



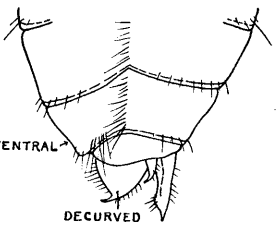
BYERS, 1937.

C. NEUROCORDULIA OBSOLETA

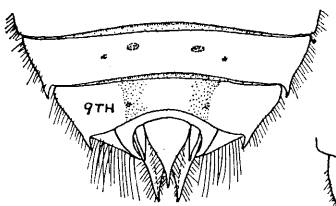


FROM EXUVIUM

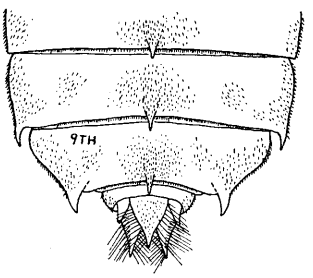
D. NEUROCORDULIA YAMASKANENSIS



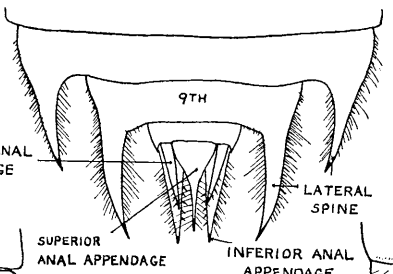
G. MESOTHEMIS LATERAL VIEW



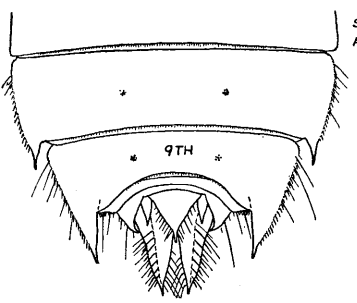
F. SYMPETRUM



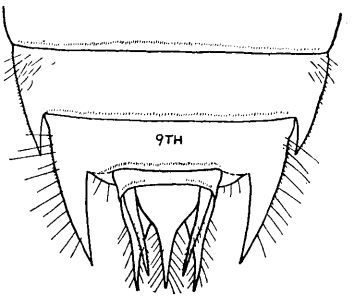
H. PERITHEMIS



J. TRAMEA



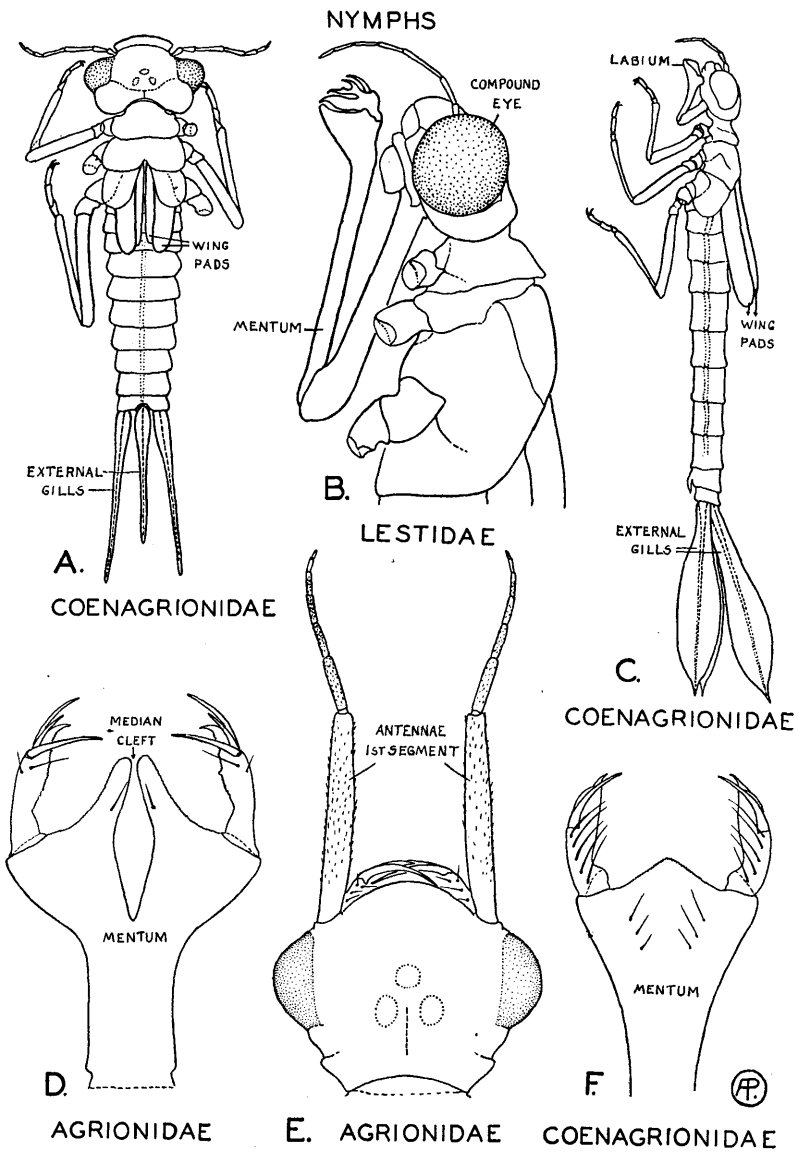
I. PACHYDIPLAX



K. PANTALA

GLOSSARY

Acute—A ridge or projection sharply pointed at apex (4 A and B).
Anal appendages—the five movable appendages (4 G and 5 J) borne on the distal end of the abdomen, namely: superior (1); inferior (2); lateral (2). See further discussion under each.
Angulate—produced into an angle, used in describing the contours of head and body surfaces. (2 K).
Apex (apical)—the distal portion or end of an appendage.
Base (basal)—the proximal portion or base of an appendage.
Cleft—On the labium a longitudinal split present on the meson of the mentum, referred to as mental or median cleft 3 O and P.
Conic- —A short, knob-like structure, used here in describing the fourth antennal segment of certain Gomphines (3 C and D).
Contour—The outline or periphery of surfaces.
Crenulate—having small blunt teeth (scallops) which are evenly rounded and rather deeply curved (3 I and J).
Crenulations—the name applied to the individual small rounded teeth described above.
Cylindrical—elongate and round, used in describing appendages (3 C, third segment).
Decurved—bent or curved downward (ventrally). Used to describe anal appendages of certain genera (5 G).
Denticulate—having small usually sharp pointed teeth (3 N).
Denticulation—term applied to an individual tooth described above.
Depressed—flattened dorso-ventrally.
Divergent—not parallel, projecting away from the median line. Used to describe certain wing pads and lateral spines. (Plate 1, compare wing pads of fig. C with those of fig. E and plate 5 C, see lateral spines of segment 8).
Dorsal hook—a stout usually prominent spine located on the mid-dorsal line of the abdominal segments (1 E and F). In some cases these may be knob-like (5 D).
Elongate—lengthened, much longer than wide. Compare 10th abdominal segments of 4 E and 4 G.
Emarginate—with an obtuse, rounded or quadrate section cut from a margin. See superior appendages of 4 F and G.
Entire—with an even, unbroken margin and not denticulate or crenulate, note distal margin of mentum (3 L).
External gills—present in the Zygoptera. These are the tracheal gills in the form of three flat or triangular, elongate plates borne on the caudal end of the abdomen. They consist of one median and two lateral gills (6 A and C).
Frontal horn—a pyramidal projection of the forehead located between the bases of the antennae (2 M and N).
Inferior anal appendages—a pair of identical structures borne on the ventro-caudal margin of the tenth abdominal segment, morphologically they are the paraprocts (subanal or podical plates) (4 G and 5 J).
Lateral anal appendages—a pair of identical structures borne on the laterio-caudal margins of the tenth abdominal segment, morphologically these are the cerci (4 G and 5 J).
Lateral lobe—a pair of variably shaped segments articulated to the disto-lateral margins of the mentum of the labium, see various figures 3 F to O.
Lateral setae—long, stout setae borne on the latero-dorsal margins of the lateral lobes (3 H to M).
Lateral spines—spine-like projections from the caudo-lateral margins of certain abdominal segments (4 G and 5 J).
Mentum—The most distal unpaired section of the labium usually bearing distinct lateral lobes. Among higher odonates it is broad, curved and spoon-shaped (3 K to O).
Mental setae—a prominent row of strong setae borne on each proximal half of the dorsal (ental) surface of the mentum. The two rows are usually identical in number and structure (3 K to M).
Mesad—Towards the median plane (or line) of the body.
Meson—the median plane (or line) of the body.
Obsolete—almost or entirely lacking; not fully developed. Used to describe crenulations of the lateral lobes of certain forms. Compare 3 I and 3 J.
Obtuse—not pointed; at an angle greater than a right angle.
Setose—thickly covered with setae (3 B, E and L).
Sub—The prefix *sub* is used to denote that the structure described is almost as noted; i. e., subcircular, suboval, subequal, subtruncate, etc.
Superior appendage—an unpaired structure borne on the mid-dorso-caudal margin of the tenth abdominal segment, morphologically the epiproct (supra-anal plate), (4 G and 5 J).
Taper-pointed—with a sharp point which may curve somewhat (3 G).
Terminal abdominal segments—segments 8, 9, and 10.
Teeth—see crenulations.
Truncate—cut off squarely at tip (3 F).
Tubercle—a rounded knob-like projection of the head or body surface (2 L).



EXPLANATION OF PLATE 6

ZYGOPTERA

A. *Coenagrionidae*, dorsal view.
B. *Lestidae*, lateral view of cephalic end.
C. *Coenagrionidae*, lateral view.
D. *Agrionidae*, mentum and lateral lobes.
E. *Agrionidae*, dorsal view of head.
F. *Coenagrionidae*, mentum and lateral lobes.

REFERENCES TO THE LITERATURE AVAILABLE FOR IDENTIFICATION OF SPECIES OF THE ANISOPTEROUS DRAGONFLIES OF THE UNITED STATES AND CANADA

PETALURIDAE

Tachopteryx.....Selys-Williamson (1901); Needham (1929).

GOMPHIDAE

Progomphus Selys.....Byers (1939). Excellent study of the genus.

Hagenius Selys.....A single species, *H. brevistylus* Selys.

Ophiogomphus Selys.....Kennedy (1917) and Walker (1933). Excellent.

Octohomphus Selys.....A single species, *O. specularis* Hagen.

Gomphoides Selys.....There are but two species at present listed under this genus: *G. williamsoni* Gloyd with the elongate tenth abdominal segment; and *G. stigmata* Say with the tenth segment normal and known only from Texas.

Erpetogomphus Selys.....There are four species in our area of which *E. designatus* been described from raised material by Hagen (1885) and *E. compositus* by supposition, see Hagen (1885).

Dromagomphus Selys.....Three known species. Only one, *D. spinosus* Selys has been described. See Garman (1927) or Byers (1930).

Lanthus Needham.....Two known species. One, *L. parvulus* Selys, described from supposition by Needham (1901).

Gomphus Leach.....This is the largest genus in our fauna, and many of the nymphs are as yet unknown. Several regional publications are of considerable value, but the collector must at all times remember that many of the species are unknown in the nymphal stage. Nymphs of this genus should be checked by some authority. The following papers may be consulted: Needham and Heywood (1929) general; Kennedy (1917) western forms; Byers (1930) southeast; Garman (1927) New England; and Walker (1928) for the subgenus *Stylurus*.

AESHNIDAE

Gomphasechna Selys.....Two species in our fauna. The generic characters of the genus are briefly indicated by Martin (1940).

Basiaeschna Selys.....A single species—*B. janata* Say.

Boyeria McLachlan.....Two species. Garman (1927), and Walker (1913 and 1915).

Anax Leach.....Byers (1927) and Calvert (1934).

Oplonaeschna Selys.....A single species, *O. armata* Hagen. Nymph unknown.

Coryphaeschna Williamson..Two species in our fauna. Kennedy (1919) described the nymph of *C. ingens* Rambur. *C. virens* Rambur is unknown in the nymphal stage.

Nasiaeschna Selys.....A single species, *N. penthacantha* Rambur.

Epiaeschna Hagen.....A single species, *E. heros* Fabricius.

Aeshna Illiger.....Composed of 18 species of which nymphs have been described for 15. See Walker (1912, 1914, 1921, 1934, and 1941) and Kennedy (1917).

Gynacantha Rambur.....Probably but a single species in our fauna, *G. nevrosa*, Rambur, which is illustrated by Williams (1937). *G. bifida* Rambur has been recorded from Florida but according to Byers (1930) an examination of material and reports leads to the belief that all such records were based on misidentification of *G. nervosa*.

Triacanthagyna Selys.....A single species in our fauna, *T. trifida* (Rambur). Nymph unknown, but probably generaically similar to *Gyncantha*.

CORDULEGASTERIDAE

Cordulegaster Leach.....Eight species have been recorded from our fauna. Needham and Heywood (1929) give a key to the nymphs of six of these. Kennedy (1917) gives excellent descriptions and illustrations of the two far western species. Byers (1930) describes the southern form.

LIBELLULIDAE

Macromiinae

Macromia Rambur.....Nine species, known from our fauna. The nymphs of four are known. Needham and Heywood (1929); Kennedy (1917) excellent illustrations; and Walker (1937) excellent illustrations.

Didymops Selys.....Two species. *D. transversa* Say well described by Byers (1930) and Garman (1927. *D. floridensis* Davis nymph unknown.

Cordulinae

Platycordulia Williamson...A single species, *P. xanthasoma* Williamson.

Neurocordulia Selys.....See Byers (1937).

Epicordulia Selys.....Two species. Needham and Heywood (1929).

Tetragoneuria Hagen.....The number of species in this genus is open to question. Very little dependence can be placed on nymphal determinations other than generic. Needham and Heywood (1929); Garman (1927); Byers (1930).

Helocordulia Needham .....Two species. Needham (1901) Needham and Heywood (1929) and Kennedy (1924).

Somatochlora Selys.....A large genus. Walker (1925) wrote an excellent monograph on the genus bringing all information up to that date. Several new species and a few nymphs have been described since.

Cordulia Leach.....A single species, *C. shurtleffi* Scudder.

Dorocordulia Needham.....Two species. See Garman (1927).

Williamsonia Davis.....Two species. The nymphs of both unknown.

Libellulinae

Nannothemis Brauer.....A single species, *N. bella* Uhler.

Perithemis Hagen.....Two species in our fauna: *P. tenera* Say U. S., described by Garman (1927) as *P. domitia*; and *P. seminole* Calvert from Florida, see Byers (1930).

Celithemis Hagen.....Eight species. The nymphs are but poorly known. See Needham and Heywood (1929), Garman (1927), and Byers (1930).

Pseudoleon Kirby.....A single species, *P. superbus* Hagen. See Needham (1937).

Erythrodiplax Brauer.....Needham (1929) and Borror (1942).

Orthemis Hagen.....A single species in our fauna, *O. ferruginea* Fabr.

Ladona Needham.....Needham and Heywood (1929), Garman (1927), and Byers (1930).

Libellula Linnaeus.....A large genus. Byers (1927a) gives very good keys to the known species. Consult also Needham and Heywood (1929) and Garman (1927).

Plathemis Hagen.....Two species. Only the nymph of *P. lydia* Drury is known. See Needham (1901).

Cannacria Kirby.....A single species in our fauna, *C. gravida* Calvert. Well illustrated by Byers (1936).

Sympetrum Newman.....A large rather difficult genus. Consult Walker (1917) and Needham and Heywood (1929).

Leucorrhinia Brittinger.....See Walker (1916, 1940) and Needham and Heywood (1929).

Pachydiplax Brauer.....A single species, *P. longipennis* Burmeister.

Erythemis Hagen (=*Mesothemis*). Two species. Only the nymph of *E. simplicicollis* Say known.

Lepthemis Hagen.....A single neotropical species which barely enters our southern border, *L. vesiculosa* Fabricius.

Dythemis Hagen.....See Needham and Heywood (1929) and Byers (1930).

Brechmorhoga Kirby.....See Needham and Fisher (1936). A single Sonoran species in our southwestern border, *B. mendax* Hagen.

Paltothemis Karsch.....A single species along the southwestern border of our area, *P. lineatipes* Karsch.

Pantala Hagen.....Two species. Needham and Heywood (1929), Garman (1927) and Kennedy (1923).

Macrodiplax Brauer.....A single species in our fauna, *M. balteata* Hagen.

Tramea Hagen.....A very difficult genus for specific nymphal determination. Best discussion by Byers (1927b).

REFERENCES CITED

Borror, D. J. 1942. A revision of the libelluline genus Erythrodiplax. Ohio State Univ. Graduate School Studies, Biological Series, Contributions in Zoo. and Ent. No. 4.

Byers, C. F. 1927a. The nymph of *Libellula insecta* and a key for the separation of the known nymphs of the genus Libellula. Ent. News 38: 113.

1927b. Notes on some American dragonfly nymphs. Jour. N. Y. Ent. Soc. 35: 65.

1930. A contribution to the knowledge of Florida Odonata. Univ. Fla. Pub., Bio. Sci. Series No. 1.

1936. The immature form of *Brachymesia gravida* Calvert, with notes on the taxonomy of the group. Ent. News 47: 35.

1937. A review of the dragonflies of the genera Neurocordulia and Platycordulia. Univ. Mich., Museum of Zoo. Misc. Publ. No. 36.

1939. A study of the dragonflies of the genus Progomphus (Gomphoides) with a description of a new species. Proc. Fla. Acad. Sci. 4: 19.

Calvert, P. P. 1934. The rate of growth, larval development and seasonal distribution of dragonflies of the genus Anax. Proc. Amer. Philo. Soc. 73: 1.

Garman, P. 1927. The Odonata or dragonflies of Connecticut. Conn. Geol. and Nat. Hist. Survey Bul. 39.

Hagen, H. A. 1885. Monograph of the earlier stages of the Odonata. Trans. Amer. Ent. Soc. 12: 249.

Kennedy, C. H. 1917. Notes on the life history and ecology of the dragonflies of Central California and Nevada. Proc. U. S. Nat. Museum 52: 483.

1919. The naiad of the Odonata genus Coryphaeschna. Ent. News 30: 105.

1923. The naiad of *Pantala hymenea* Say. Can. Ent. 54: 36.

1924. Notes and descriptions of naiads belonging to the dragonflies genus Helocordulia. Proc. U. S. Nat. Museum 64: 1.

Martin, E. C. 1940. The nymphal skin of Gomphaeschna Selys. Jour. Ala. Acad. Sci. 12, part 2: pp. 66.

Needham, J. G. 1901. On aquatic insects in the Adirondacks. N. Y. State Mus. Bul. 47: 429.

1937. The nymph of *Pseudoleon superhus* Hagen. Reprint from December 1937 issue Pomona College Jour. Ent. and Zoo.

Needham, J. G., and **Heywood, H. B.** 1929. A handbook of the dragonflies of North America. C. C. Thomas, Publisher, Springfield, Illinois.

Needham, J. G., and **Fisher, E.** 1936. The nymphs of North American dragonflies. Trans. Amer. Ent. Soc. 62: 107.

Walker, E. M. 1912. The North American dragonflies of the genus Aeshna. Univ. Toronto Studies, Biol. Series II.

1913. New nymphs of Canadian Odonata. Can. Ent. 45: 161.

1914. New and little known nymphs of Canadian Odonata. Can. Ent. 46: 349 and 369.

1915. Notes on the Odonata of the vicinity of Go Home Bay, Georgian Bay, Ontario. Suppl. 47th Ann. Rept. Dept. Marine and Fisheries, Fish Branch, 53–94.

1916. Nymphs of the North American species of Leucorrhinia. Can. Ent. 48: 414.

1917. The known nymphs of the North American species of Sympetrum. Can. Ent. 49: 409.

1921. The nymph and breeding place of *Aeshna sitchensis* Hagen. Can. Ent. 53: 221.

1925. The North American dragonflies of the genus Somatochlora. Univ. Toronto Studies, Biol. Series No. 26.

1928. The nymphs of the Stylurus group of the genus Gomphus with notes on the distribution of this group in Canada. Can. Ent. 60: 78.

1933. The nymphs of the Canadian species of Ophiogomphus. Can. Ent. 65: 217.

1934. The nymphs of *Aeshna juncea* L. and *A. subarctica* Wlk. Can. Ent. 66: 267.

1937. A new Macromia from British Columbia. Can. Ent. 69: 5.

1940. Odonata from the Patricia portion of the Kenora District of Ontario, with a description of a new species of Leucorrhinia. Can. Ent. 72: 4.

1941. The nymph of *Aeshna verticalis* Hagen. Can. Ent. 73: 229.

Williams, F. X. 1937. Notes on the biology of *Gynacantha nervosa* Rambur, a crepuscular dragonfly in Guatemala. Pan-Pacific Ent. 13: 1.

Williamson, E. B. 1901. On the manner of oviposition and on the nymph of *Tachopteryx thoreyi* Hagen. Ent. News 12: 1.